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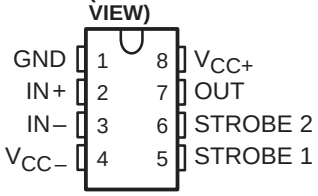
# LM306
# DIFFERENTIAL COMPARATOR WITH STROBES

SLCS008A – OCTOBER 1979 – REVISED OCTOBER 1991

- **Fast Response Times**
- **Improved Gain and Accuracy**
- **Fanout to 10 Series 54/74 TTL Loads**
- **Strobe Capability**
- **Short-Circuit and Surge Protection**
- **Designed to Be Interchangeable With National Semiconductor LM306**

**D OR P PACKAGE**
**(TOP VIEW)**



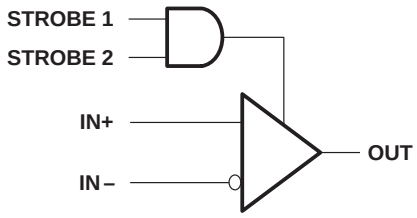

## description

The LM306 is a high-speed voltage comparator with differential inputs, a low-impedance high-sink-current (100 mA) output, and two strobe inputs. This device detects low-level analog or digital signals and can drive digital logic or lamps and relays directly. Short-circuit protection and surge-current limiting is provided.

A low-level input at either strobe causes the output to remain high regardless of the differential input.When both strobe inputs are either open or at a high logic level, the output voltage is controlled by the differential input voltage. The circuit will operate with any negative supply voltage between –3 V and –12 V with little difference in performance.

The LM306 is characterized for operation from 0°C to 70°C.

## functional block diagram




**AVAILABLE OPTIONS**

| $T_A$ | $V_{IO}$max at 25°C | PACKAGE | |
|---|---|---|---|
| | | SMALL OUTLINE (D) | PLASTIC DIP (P) |
| 0°C to 70°C | 5 mV | LM306D | LM306P |

PRODUCTION DATA information is current as of publication date. Products conform to specifications per the terms of Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.

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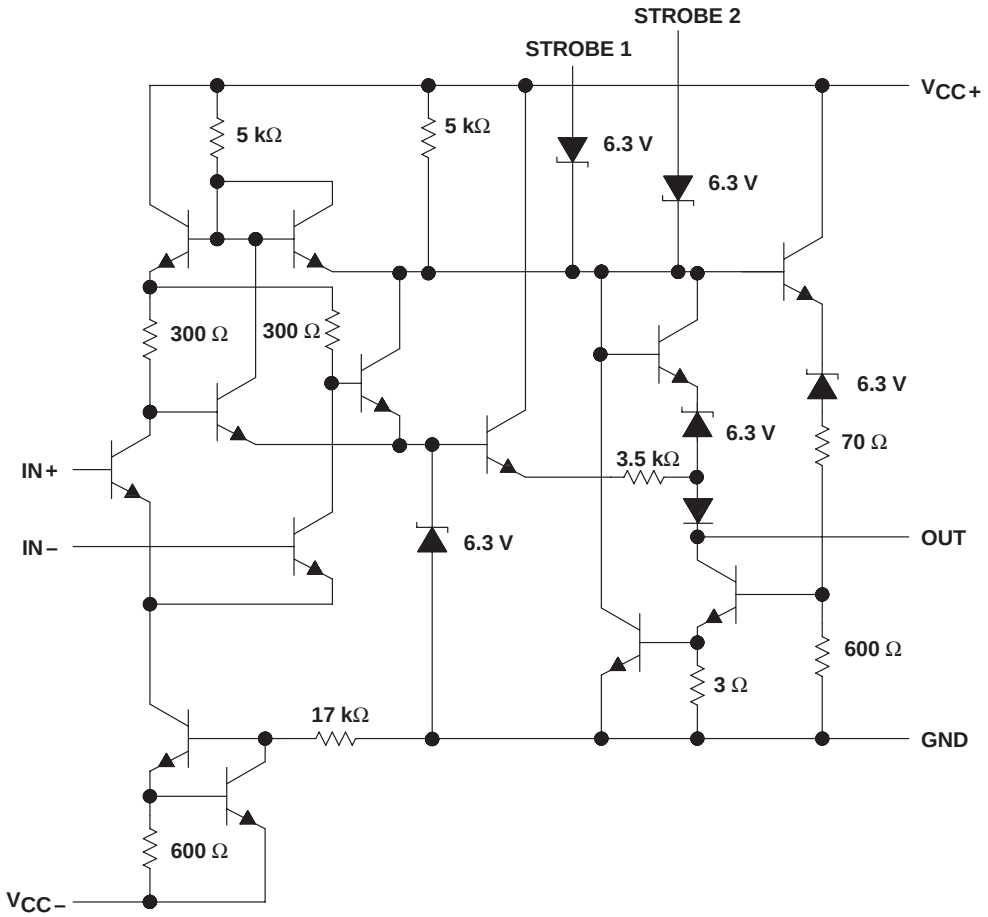
## schematic




Resistor values are nominal.

## absolute maximum ratings over operating free-air temperature range (unless otherwise noted)†

Supply voltage, $V_{CC+}$ (see Note 1) . . . . . 15 V
Supply voltage, $V_{CC-}$ (see Note 1) . . . . . –15 V
Differential input voltage, $V_{ID}$ (see Note 2) . . . . . ±5 V
Input voltage, $V_I$ (either input, see Notes 1 and 3) . . . . . ±7 V
Strobe voltage range (see Note 1) . . . . . 0 V to $V_{CC+}$
Output voltage, $V_O$ (see Note 1) . . . . . 24 V
Voltage from output to $V_{CC-}$ . . . . . 30 V
Duration of output short circuit to ground (see Note 4) . . . . . 10 s
Continuous total dissipation . . . . . See Dissipation Rating Table
Operating free-air temperature range, $T_A$ . . . . . 0°C to 70°C
Storage temperature range . . . . . –65°C to 150°C
Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds . . . . . 260°C

† Stresses beyond those listed under “absolute maximum ratings” may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under “recommended operating conditions” is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

NOTES: 1. All voltage values, except differential voltages and the voltage from the output to $V_{CC-}$, are with respect to the network ground.
2. Differential voltages are at IN+ with respect to IN–.
3. The magnitude of the input voltage must never exceed the magnitude of the supply voltage or 7 V, whichever is less.
4. The output may be shorted to ground or either power supply.

**DISSIPATION RATING TABLE**

| PACKAGE | $T_A \le 25°C$ POWER RATING | DERATING FACTOR | DERATE ABOVE $T_A$ | $T_A = 70°C$ POWER RATING |
|---|---|---|---|---|
| D | 600 mW | 5.8 mW/°C | 46°C | 464 mW |
| P | 600 mW | 8.0 mW/°C | 75°C | 600 mW |

## electrical characteristics at specified free-air temperature, $V_{CC+}$ = 12 V, $V_{CC-}$ = –3 V to –12 V (unless otherwise noted)

| PARAMETER | | TEST CONDITIONS† | | $T_A$‡ | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|---|---|
| $V_{IO}$ | Input offset voltage | $R_S \le 200\ \Omega$ | | 25°C | | 1.6§ | 5 | mV |
| | | | | Full range | | | 6.5 | |
| $\alpha_{VIO}$ | Average temperature coefficient of input offset voltage | $R_S$ = 50 Ω, | See Note 5 | Full range | | 5 | 20 | μV/°C |
| $I_{IO}$ | Input offset current | See Note 5 | | 25°C | | 1.8 | 5 | μA |
| | | | | MIN | | 1 | 7.5 | |
| | | | | MAX | | 0.5 | 5 | |
| $\alpha_{IIO}$ | Average temperature coefficient of input offset current | See Note 5 | | MIN to 25°C | | 24 | 100 | nA/°C |
| | | | | 25°C to MAX | | 15 | 50 | |
| $I_{IB}$ | Input bias current | $V_O$ = 0.5 V to 5 V | | MIN to 25°C | | | 40 | μA |
| | | | | 25°C to MAX | | 16 | 25 | |
| $I_{IL(S)}$ | Low-level strobe current | $V_{(strobe)}$ = 0.4 V | | Full range | | –1.7 | –3.2 | mA |
| $V_{IH(S)}$ | High-level strobe voltage | | | Full range | 2.2 | | | V |
| $V_{IL(S)}$ | Low-level strobe voltage | | | Full range | | | 0.9 | V |
| $V_{ICR}$ | Common-mode input voltage range | $V_{CC-}$ = –7 V to –12 V | | Full range | ±5 | | | V |
| $V_{ID}$ | Differential input voltage range | | | Full range | ±5 | | | V |
| $A_{VD}$ | Large-signal differential voltage amplification | $V_O$ = 0.5 V to 5 V, | No load | 25°C | | 40 | | V/mV |
| $V_{OH}$ | High-level output voltage | $I_{OH}$ = –400 μA | $V_{ID}$ = 8 mV | Full range | 2.5 | | 5.5 | V |
| $V_{OL}$ | Low-level output voltage | $I_{OL}$ = 100 mA | $V_{ID}$ = –7 mV | 25°C | | 0.8 | 2 | V |
| | | $I_{OL}$ = 50 mA | $V_{ID}$ = –7 mV | Full range | | | 1 | |
| | | $I_{OL}$ = 16 mA | $V_{ID}$ = –8 mV | Full range | | | 0.4 | |
| $I_{OH}$ | High-level output voltage | $V_{OH}$ = 8 V to 24 V | $V_D$ = 7 mV | MIN to 25°C | | 0.02 | 2 | μA |
| | | | $V_{ID}$ = 8 mV | 25°C to MAX | | | 100 | |
| $I_{CC+}$ | Supply current from $V_{CC+}$ | $V_{ID}$ = –5 mV, | No load | Full range | | 6.6 | 10 | mA |
| $I_{CC-}$ | Supply current from $V_{CC-}$ | No load | | Full range | | –1.9 | –3.6 | mA |

† Unless otherwise noted, all characteristics are measured with both strobes open.
‡ Full range is 0°C to 70°C. MIN is 0°C. MAX is 70°C.
§ This typical value is at $V_{CC+}$ = 12 V, $V_{CC-}$ = –6 V.

NOTE 5: The offset voltages and offset currents given are the maximum values required to drive the output down to the low range ($V_{OL}$) or up to the high range ($V_{OH}$). These parameters actually define an error band and take into account the worst-case effects of voltage gain and input impedance.

## switching characteristics, $V_{CC+}$ = 12 V, $V_{CC-}$ = –6 V, $T_A$ = 25°C

| PARAMETER | TEST CONDITIONS† | | | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|---|
| Response time, low-to-high-level output | $R_L$ = 390 Ω to 5 V, | $C_L$ = 15 pF, | See Note 6 | | 28 | 40 | ns |

† All characteristics are measured with both strobes open.

NOTE 6: The response time specified is for a 100-mV input step with 5-mV overdrive and is the interval between the input step function and the instant when the output crosses 1.4 V.

## TYPICAL CHARACTERISTICS

### Table of Graphs

| | | | FIGURE |
|---|---|---|---|
| $I_{IB}$ | Input bias current | vs Free-air temperature | 1 |
| $I_{IO}$ | Input offset current | vs Free-air temperature | 2 |
| $V_{OH}$ | High-level output voltage | vs Free-air temperature | 3 |
| $V_{OL}$ | Low-level output voltage | vs Free-air temperature | 4 |
| $V_O$ | Output voltage | vs Differential input voltage | 5 |
| $I_O$ | Output current | vs Differential input voltage | 6 |
| $A_{VD}$ | Large-signal differential voltage amplification | vs Free-air temperature | 7 |
| $I_{OS}$ | Short-circuit output current | vs Free-air temperature | 8 |
| | Output response | vs Time | 9, 10 |
| $I_{CC+}$ | Positive supply current | vs Positive supply voltage | 11 |
| $I_{CC-}$ | Negative supply current | vs Negative supply voltage | 12 |
| $P_D$ | Total power dissipation | vs Free-air temperature | 13 |

**INPUT OFFSET CURRENT vs FREE-AIR TEMPERATURE**

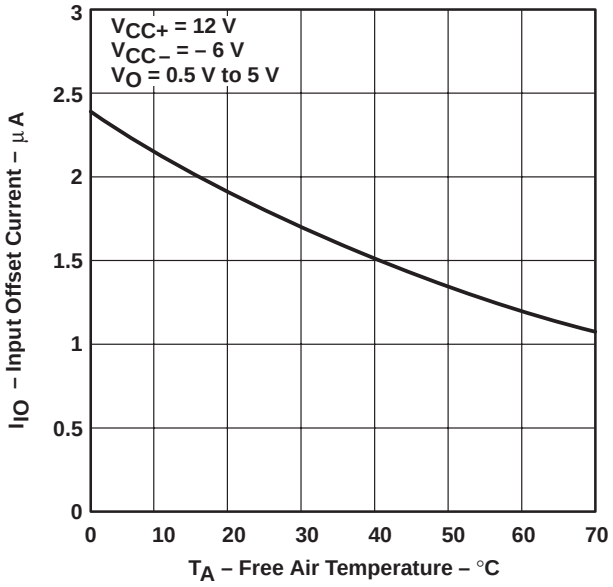



**Figure 1**

**INPUT BIAS CURRENT vs FREE-AIR TEMPERATURE**

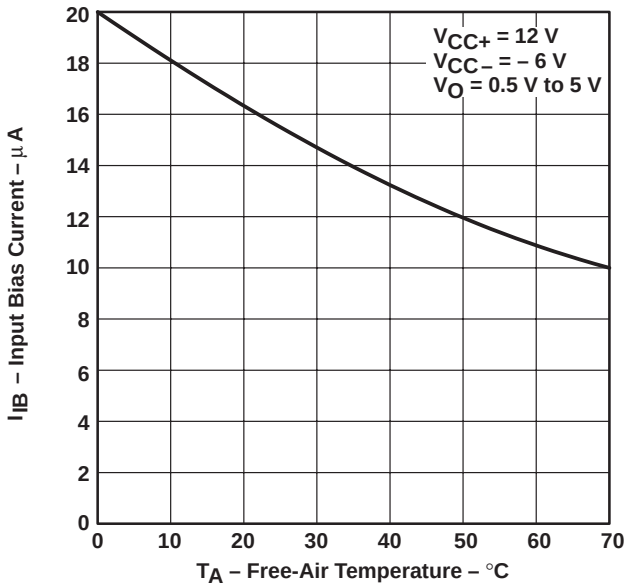



**Figure 2**

## TYPICAL CHARACTERISTICS

**HIGH-LEVEL OUTPUT VOLTAGE vs FREE-AIR TEMPERATURE**

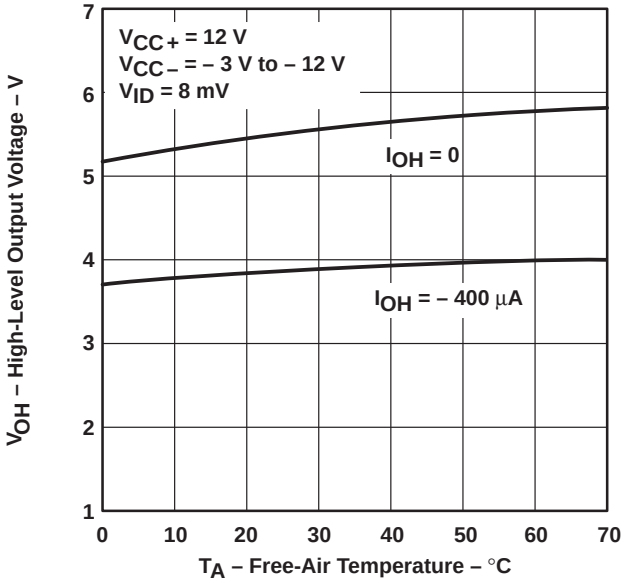



Figure 3

**LOW-LEVEL OUTPUT VOLTAGE vs FREE-AIR TEMPERATURE**

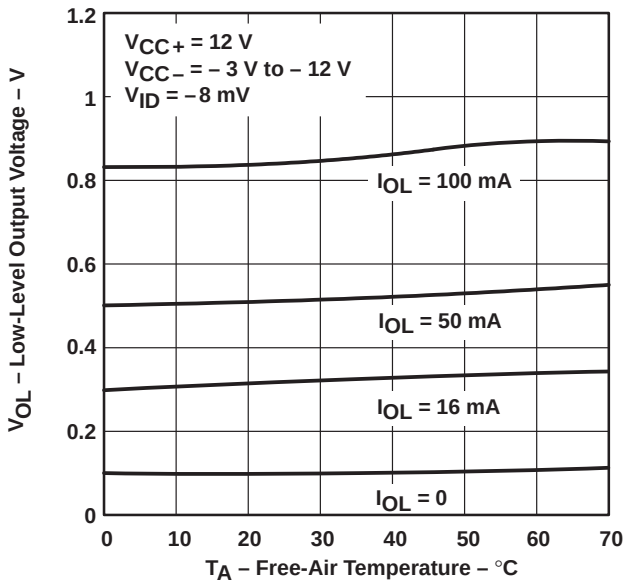



Figure 4

**OUTPUT VOLTAGE vs DIFFERENTIAL INPUT VOLTAGE**

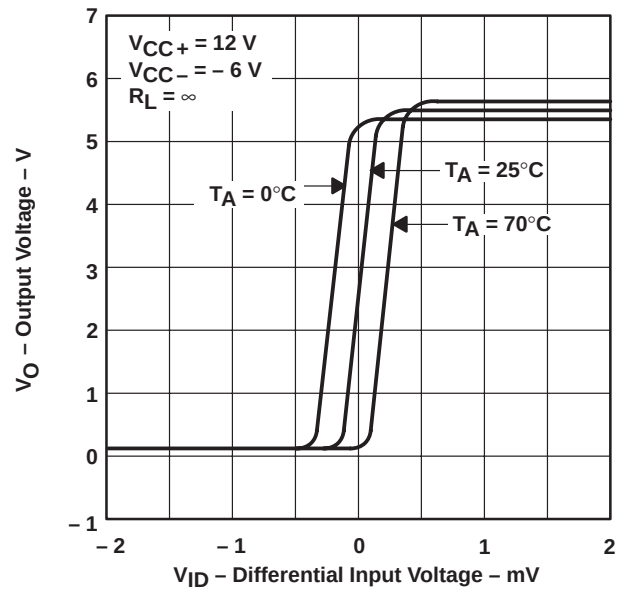



Figure 5

**OUTPUT CURRENT vs DIFFERENTIAL INPUT VOLTAGE**

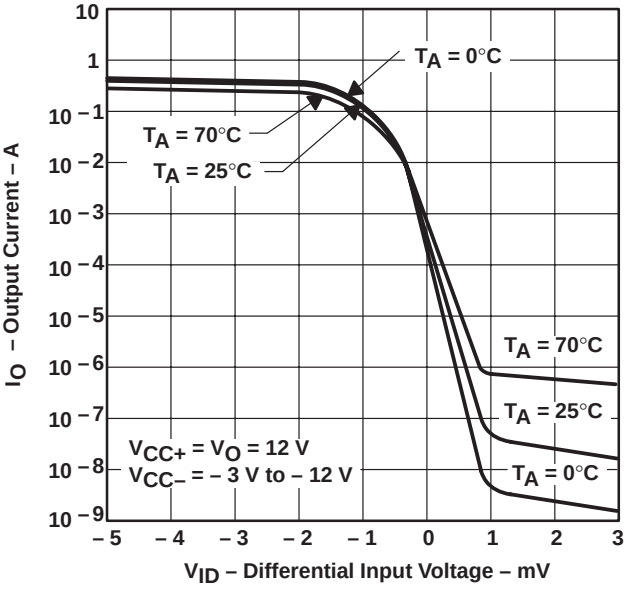



Figure 6

## TYPICAL CHARACTERISTICS

**LARGE-SIGNAL DIFFERENTIAL VOLTAGE AMPLIFICATION vs FREE-AIR TEMPERATURE**

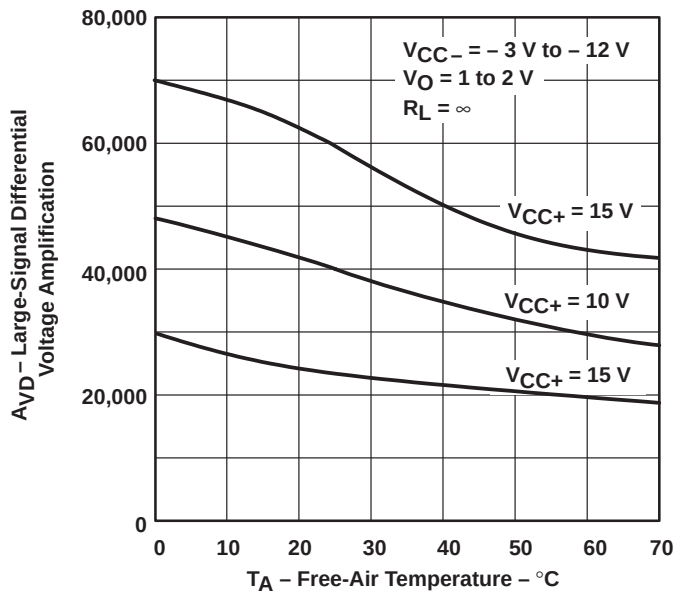
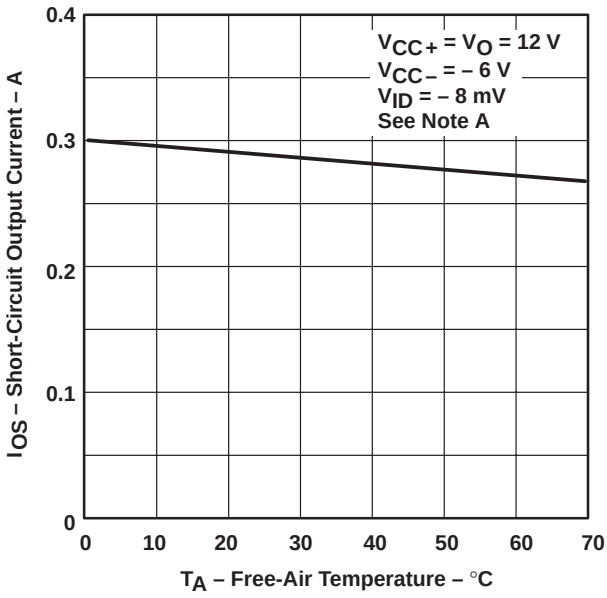



Figure 7

**SHORT-CIRCUIT OUTPUT CURRENT vs FREE-AIR TEMPERATURE**




NOTE A: This parameter was measured using a single 5-ms pulse.

Figure 8

**OUTPUT RESPONSE FOR VARIOUS INPUT OVERDRIVES**

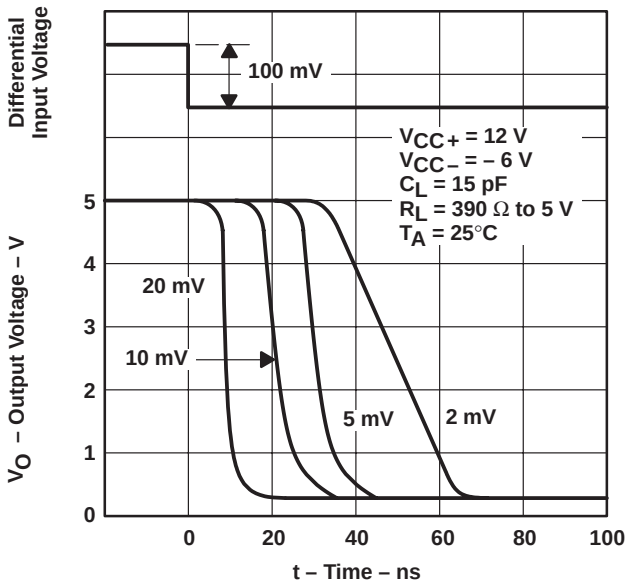



Figure 9

**OUTPUT RESPONSE FOR VARIOUS INPUT OVERDRIVES**

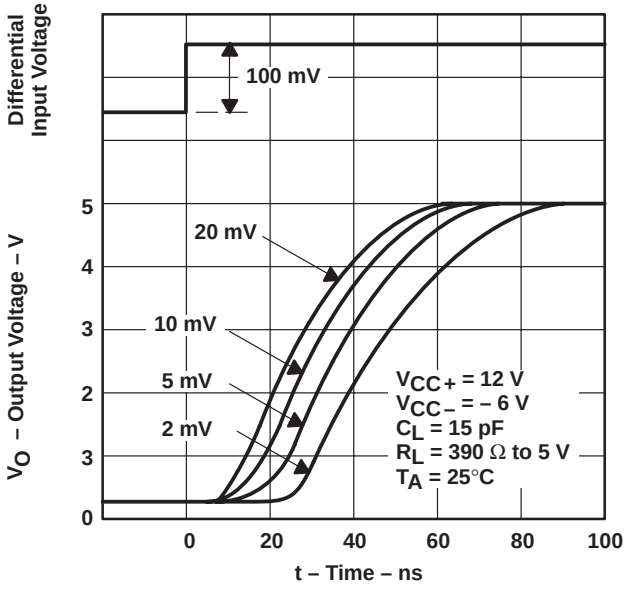



Figure 10

## TYPICAL CHARACTERISTICS

**POSITIVE SUPPLY CURRENT
vs
POSITIVE SUPPLY VOLTAGE**

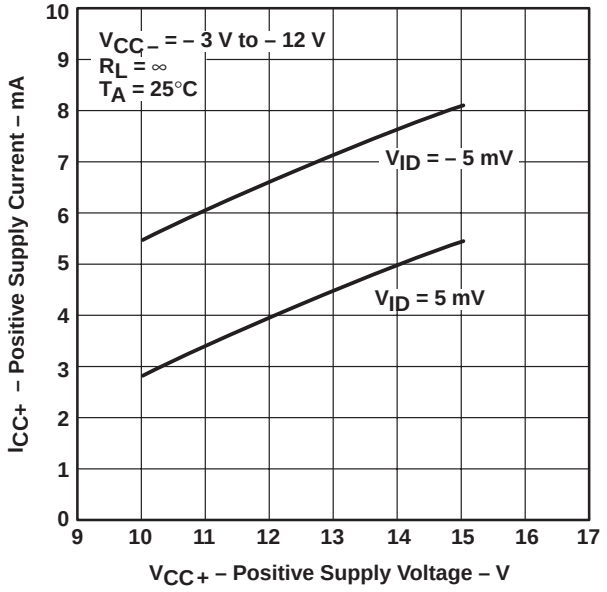



**Figure 11**

**NEGATIVE SUPPLY CURRENT
vs
NEGATIVE SUPPLY VOLTAGE**

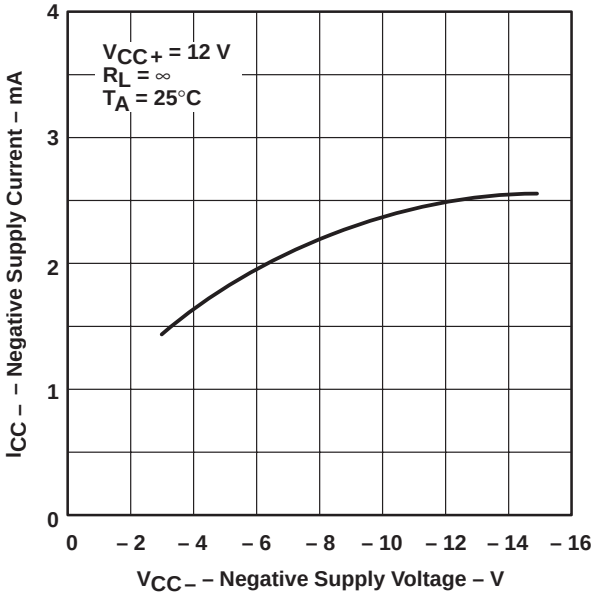



**Figure 12**

**TOTAL POWER DISSIPATION
vs
FREE-AIR TEMPERATURE**

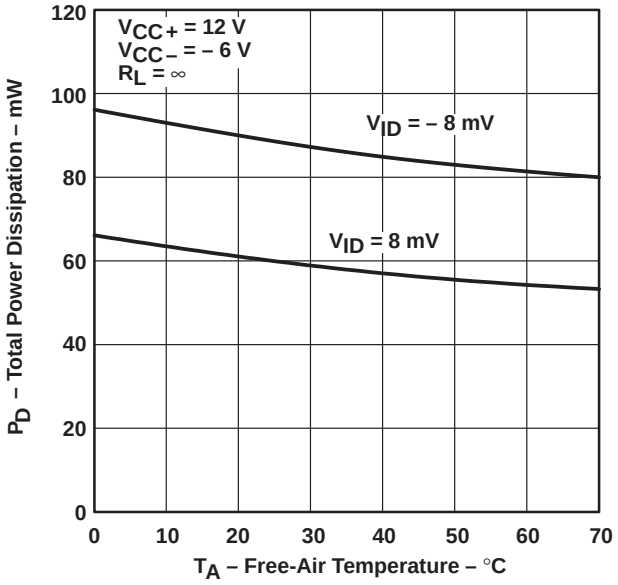



**Figure 13**

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